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ROUGH DRAFT

POLAR RESEARCH IN SOIL SCIENCE

Part I. Manpower

The 24 universities reporting indicate a total of 33 professional level department members currently or previously active in polar research and an overall total of 107 professional level men who could participate if given the opportunity. Of the 920 graduate students reported, 2% have done or are doing research in polar areas.

Part II. Special Facilities

1. 50% of the departments reporting have indicated special equipment for polar research; these include:

U. ALASKA - two 300 acre farms in sub-arctic environment; system of cooperative research with Alaska's agriculture industry; cold room lab; humidity and temp. chambers; field and lab facilities for plant and animal nutrition work.

DUKE - Plant and Soil chemical analysis - flame photometer, Careon induction furnace, Kieloahl apparatus; Soil Moisture measurement - portable scaler and probe for neutron scattering moisture measurements.

U. GEORGIA - cold room; growth chamber.

U. MINNESOTA - soil physics lab; soil climatology lab; cold room lab; controlled climate facility.

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U. NEW HAMPSHIRE - cold room 9'x9' with turn-table; control room for hardening plants with lights; growth chamber with tanks for controlling soil temp; equip. for physical measurements on soils.

OHIO STATE - plant growth chambers; radiation counting equipment including a 400 channel analyzer; infrared spectrophotometer; x-ray spectrometer; differential thermal analyses equipment; electrophoresis equipment; soil physics equipment.

PURDUE - 9'x 12' cold room with small controlled freezing cabinets and a testing machine inside; potentiometric temperature measuring equipment.

SYRACUSE - cold room lab; low temperature cabinet; low temperature indicating equipment.

UTAH STATE - 7 constant temperature and cold rooms.

U. WASHINGTON - cold room (6'x 8'); specimen tank in cold room (2' x 5') with circulating brine (-20°F), connected with warm brine tank for alternate freeze and thaw cycles; frost cabinet; test track with facilities for moving wheel loads, soil pressure cells and connection to cold brine tank for frost experiments; soil mechanics aggregates, concrete and bituminous paving mix laboratories.

WASHINGTON STATE - growth chambers; soils lab.

YALE - low temperature apparatus capable of taking temperatures down to -130°F.

The University of Nebraska indicated that constant temperature growth chambers are being planned.

2. Two of the departments reporting, U. of Washington and Stanford, comprising 9%, have a small separate polar library; 22% maintain a department library which keeps most classical and present polar books; 44% rely on the standard publications in a general library; 26% have very limited polar library facilities; and 4% have no polar library.

3. 17% report special collections and are listed as follows:

U. ALASKA - plant materials - indigenous grasses and legumes, fruits, adapted exotic woody materials.

DUKE - plant specimens.

PURDUE - map and aerial photography collections of arctic and sub-arctic regions.

U. NEW HAMPSHIRE - approximately 300 arctic species of plants.

Part III. Curiculum

1. Of the 23 universities reporting, 3 offer courses which are primarily concerned with polar problems (13%). They are as follows:

U. ALASKA - Forest Soils; Av. 4 graduates and 12 undergraduates, given every other year, S. A. Wilde.

OHIO STATE - Seminar on Polar Soils; every other year, 3 staff members.

STANFORD - Permafrost (geocryology); Av. 12 grad students, given every other year; S. W. Muller.

2. U. Alaska contemplates a future course in Forest Soils for undergraduates and graduates. Prof. C. W. Lovell of Purdue expressed a personal desire to teach a duo-level course on distribution, properties, and problems of frozen ground, but no definite plans have been completed.

3. 21% of departments reporting had theses written on polar problems in the past five years; U. of Washington reports 4 M.S. theses related to polar areas completed in the past five years; U. of Alaska, Purdue, and Stanford report 1 Ph.D. thesis, respectively, and Rutgers 2 Ph.D. theses completed in the past five years.

4. 17% of the 24 universities report current theses in polar areas; Rutgers, Purdue, and Stanford each have 2 current Ph.D. theses dealing with polar areas underway. U. of New Hampshire reports 2 on M.S. level.

Part IV. Polar Experience, Where Gained.

23% of the graduate students working in Soil Science have had experience in polar research. 50% of these were from government sponsored expeditions, 37% from private sponsored expeditions, and Stanford indicated experience derived from exploration for an oil company.

Part V. Research Activities.

1. 33% of the departments have polar research currently under way:

U. of NEW HAMPSHIRE - effect of soil temp. on growth of plants and the movement of ions in soils. Winterhardiness of white clover.

SOUTH DAKOTA STATE COLLEGE - frost features in soils of non-glaciated area of South Dakota.

U. NEBRASKA - study of interrelations of arctic pedology, topography, and vegetation in an area of forest-tundra transition (ONR-222). Supported by AINA for 2 years ending June 1960. Logistics by Arctic Research Lab.

STANFORD - General manual on Permafrost. U.S. Armed Forces grant. Logistics provided by U.S. Armed Forces and U.S. Geological Survey.

PURDUE - 1) strength properties of partially frozen soils; NSF grant; 2 years; Purdue Research Foundation provides logistics. 2) Freezing barriers for highways and airfields; grant from Dow Chemical Company; 2 years; Purdue Research Foundation provides logistics.

YALE - early forest conditions in Alaska interior; an history survey.

RUTGERS - Arctic pedologic studies; AINA grant, ONR; running since 1953; logistics by Arctic Research Laboratory.

U. ALASKA - Alaska Agricultural Experiment Station.

2. Only 8% reported polar work completed within the past five years:

PURDUE - certain characteristics of partially frozen soils; SIPRE, 3 years; Engineering Experiment Station.

YALE - 1) aboriginal man and white man as causes of fires in the boreal forest, with particular reference to Alaska. Yale Forestry School. Bul. 65, 1959. 2) indicators of forest land classes in air-photo interpretation of the Alaska interior. Funds from U.S. Forest Service. Forest Service supplied logistics. 3) history of the early occurrence of moose on the Kenai Peninsula and in other sections of Alaska. 4) Ecological effects of forest fires in the interior of Alaska. U.S. Dept. of Agri., Tech. Bul. 1133, 1956. Funds from U.S. Forest Service, logistic support adequate.

3. 25% of the departments reporting have expressed the intent to continue with research in polar areas in the field of soil science:

U. ILLINOIS - evaluation of methods of large scale weather modification over Arctic regions. To be submitted to NSF and cover a 3-5 year period. U.S. Navy and U.S. Air Force logistic support will be requested.

SYRACUSE - load and deformation characteristics of permafrost -- long term loading conditions. Long term deformation conditions. Transmission of impact waves through permafrost.

RUTGERS - continuation of studies in northern Alaska, and possibly observations in other Arctic regions of the northern hemisphere to see if concepts and findings have circumpolar application. Logistic support from A.R.L. at Point Barrow reported as very satisfactory.

YALE - desires to undertake an investigation of geology and soil parent material in relation to forest vegetation in the Alaska interior. Particular attention would be paid to occurrence of altitudinal and latitudinal timberlines in relation to limestone, ultrabasic rocks and other rock types known or suspected to lead to unusual soil conditions.

PURDUE - continuation of present contracts on Strength Properties of Partially Frozen Soils (NSF) and Freezing Barriers for Highways and Airfields (Dow Chemical).

SOUTH DAKOTA - continuation of projects on soil classification in the state; studies on plant winterhardiness.

4. The following departments have outlined deficiencies which they find in the polar research program in soil science as a whole, and problems which would be of value to them to have work done on:

U. NEBRASKA - Views of Dr. J. V. Drew on Arctic research problems in soil science:

The soils of North American Arctic are relatively unstudied -- in marked contrast to frequency and

abundance of published reports dealing with arctic soils in Soviet soil science literature.

Departure from traditional methods of studying soil geography are needed to guard against inconclusive results due to inability of field men to observe distant outcrops, topographic variations, or field conditions beyond limits of available ground transportation. Proven use of helicopters in topographic survey and petroleum exploration in the flat treeless tundra suggests that the use of these machines would expedite geographic aspects of polar soils research.

Areas of needed research: 1) A continuation of exploration and the description and classification of arctic soils is a primary step in developing a systematic approach to an understanding of the arctic environment. 2) Many measurements of physical soil properties and conditions have not been made, i.e. soil moisture regime inadequately understood in arctic soils. Are the permafrost block to internal soil drainage and the low thermal efficiency of the arctic climate entirely responsible for the wet soil conditions? Do appreciable amounts of atmospheric moisture condense directly into arctic soils? How much lateral movement of water occurs in arctic soils and what is its effect on

the soil environment? 3) Qualitative measurements on rate of frost action needed. Long term study plots need to be set up in areas of frost-caused features. Perhaps the use of radioactive materials has application in studying rate & amt. of soil movement resulting from frost action. 4) Soil chemistry procedures and fundamental problems of soil-plant relationships relatively unstudied in the arctic. 5) Studies concerning microbiology of arctic soils needed to establish rate of organic matter decomposition and the availability of certain nutrient elements for plant growth.

PURDUE - suggests the following deficiencies: 1) qualified faculty to direct high-quality, scientifically oriented research; 2) sponsors for graduate research programs; 3) funds for increasing and improving the physical laboratory facilities for frozen ground research. Prof. C. W. Lovell expressed desire of Civil Engineering Department at Purdue to continue activity in engineering problems of polar regions.

U. MASSACHUSETTS - states the need for correlation of research and practice for design, construction and maintenance of road and foundations in sub-arctic regions.

YALE - indicated information on these topics would be valuable:

"Possibility and effects of maintaining the level or position of permafrost under managed forest stands." Should probably be done in cooperation

with U.S. Forest Service and/or Bureau of Land Management.

"Effects of human occupation on the chemical properties of soils of archeological sites."

"Ecology of forest soil arthropods in the boreal forest." Knowledge of this group would contribute to an understanding of the development of the forest humus layers in the north.

U. MINNESOTA - an interest expressed in the soil physics of frozen soils. Working funds and support would be required.

SOUTH DAKOTA STATE - studies of physiology of polar plants might be of value to section of Agronomy Department studying plant winterhardiness.

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